

**A Mussel Survey of
St. Catherine Creek National Wildlife Refuge**

by:

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Table of Contents

| | |
|-------------------------------|----|
| Introduction | 1 |
| Mussel Identification | 2 |
| Life History and Reproduction | 4 |
| Mussel Species List | 6 |
| Flat Floater | 7 |
| Yellow Sandshell | 8 |
| Fragile Papershell | 9 |
| Pondmussel | 10 |
| Fat Pocketbook | 11 |
| Pink Papershell | 12 |
| Giant Floater | 13 |
| Southern Mapleleaf | 14 |
| Mapleleaf | 15 |
| Lilliput | 16 |
| Texas Lilliput | 17 |
| Pondhorn | 19 |
| Paper Pondshell | 20 |
| Asian Clam | 21 |
| Survey Sites | 22 |
| References | 24 |

Introduction

Freshwater mussels are one of the most imperiled groups of animals in North America. Currently 70 mussel species are listed as endangered or threatened under the Endangered Species Act, and a number of others are candidates or potential candidates for protection. Affected by siltation, erosion, polluted runoff, impoundment, channelization, habitat fragmentation, and population isolation, even common and widespread species have declined dramatically from historic levels.

Mussels have been economically tied to the Mississippi River delta and its drainages since prehistoric times. Native Americans not only ate mussels, but also used them for tools, containers, utensils, and jewelry. Early European settlers also consumed them during hard times, and often harvested natural pearls from them. During the late 1800's and early 1900's, mussel shells were harvested to make highly prized pearl buttons, which were shipped throughout the world and became a multi-million dollar industry. During the 1940's the pearl button industry collapsed due to the invention and wide-spread use of plastics. However, about the same time the Japanese cultured pearl industry was coming into its own.

Mussels continue to contribute to the economy today. Few Americans realize that freshwater mussel shells are the primary source of nuclei for the world-wide cultured pearl industry. Shells are still collected and shipped to Japan, China, the Pacific Islands, and Australia where they are cut and rounded into beads for insertion into oysters as nuclei for cultured pearls.

Archaeological and historical accounts suggest the mussels once paved the bottoms of Mississippi Delta Rivers and streams. As filter feeders they removed sediments and detritus from the water. Their partially digested excretion was food for many aquatic invertebrates and fishes.

Mussels are also important indicators of aquatic ecosystem health. Their complex life cycle requires a healthy fish community, stable substrates, and relatively clean water. Changes in water quality, channel stability, or fish density and diversity are usually reflected by a decline in abundance or a loss of species within the mussel community. Monitoring the health and diversity of the mussels within a drainage system is an important tool in aquatic ecosystem management.

St. Catherine Creek encompasses a small portion of the Mississippi River alluvial plain between the loess hills and the Mississippi River. The primary drainage is St. Catherine Creek, but the refuge also contains lakes, oxbows, swamps, sloughs, and numerous ditches. St. Catherine Creek is now separated from its drainage system by levies, and the Refuge portion is now maintained by local rainfall, groundwater, springs, and overflow from the Mississippi River during floods. In the 1990's it was discovered that the Creek on the Refuge supported the southernmost known population of the endangered fat pocketbook mussel, as well as other mussel species. One of the purposes of this survey was to determine the distribution and current status of the fat pocketbook on the refuge

MUSSEL IDENTIFICATION

The most obvious and persistent feature of the freshwater mussel is its shell. Features used to separate species include the thickness of the shell, presence or absence of teeth inside the shell, presence or absence of pustules and/or ridges, color of the inside or outside of the shell, etc. It is important to realize that features of the shells can be highly similar between species, as well as variable within a species. Figure 1 shows the basic anatomy of a mussel shell. The anterior end of a mussel shell can be determined by the position of the umbo and pseudocardinal teeth. These are both located anteriorly. In living mussels the more elongate end is usually the posterior end. When replacing a living mussel back into the substrate, it is very important to place the anterior end down, leaving the posterior end exposed to the water.

Important identification characters inside the shell include the nacre color, length and shape of the lateral and pseudocardinal teeth, and depth of the beak cavity. External characters include the color of the periostracum (external skin), and the presence or absence of colored rays; the shape, number, and arrangement of pustules or ridges; the presence or absence of a sulcus or shallow depression running from the beak to the ventral margin of the shell; and the presence or absence of a posterior ridge.

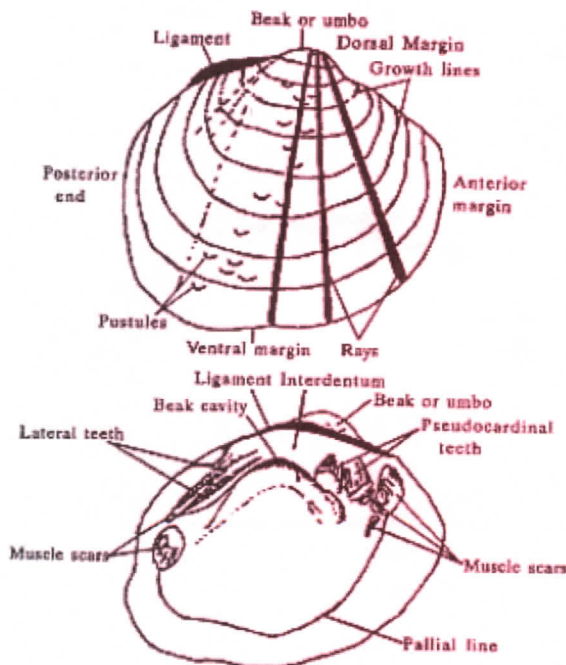


Figure 1: the shell of a Freshwater Mussel

Internal anatomy, or "soft part" characters, are used in classification of mussels into families, genera, and species (Figure 2). The most prominent of these include the number of gills used as marsupia for the larvae, the size and shape of the marsupium, the anatomy of the larvae (glochidia), labial palps, siphons, and mantle characters.

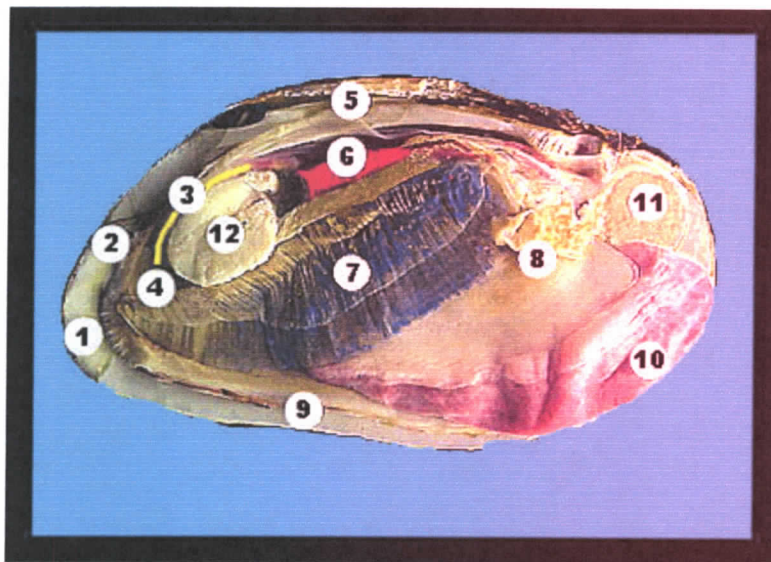


Figure 2: the Body of a Freshwater Mussel

- Key:
- 1: Incurrent siphon
 - 2: Excurrent siphon
 - 3: Intestine
 - 4: Anus
 - 5: Hinge ligament
 - 6: Heart
 - 7: Gills
 - 8: Labial palps
 - 9: Mantle
 - 10: Foot
 - 11: Ant. adductor muscle
 - 12: Post adductor muscle

Freshwater Mussel Life History and Reproduction



Mussel Glochidia

Most fresh water mussels have two separate sexes. A few however, such as the paper pondshell (*Utterbackia imbecillis*), and the lilliput (*Toxolasma parvus*), are hermaphroditic, or have both male and female sex organs. Typically, the males release sperm into the water. The females take in the sperm through the incurrent siphon. Eggs are kept in the water tubes of the female's gills. As water is pumped into the gills, the eggs are fertilized and then develop into larvae, called glochidia. The glochidia lack several of the organs of the adult mussels, and must go through metamorphosis before they can live independently.

In the south eastern United States, virtually all native mussels are parasitic during their larval stage. The glochidia of most of these mussel species use fish as hosts, but some have been known to use other aquatic vertebrates like frogs. For some mussels, only a few species of fish can host the glochidia, but for other mussels, the glochidia can attach to many different kinds of fish. If successful, the larval mussels attach to the gills or fins (depending on the species of mussel) of a host fish where they finish metamorphosis. If the glochidia do not attach to an appropriate host, they cannot survive.

There are many ways in which a female mussel can find a host fish for her young glochidia. A few species of fresh water mussels simply release their larvae as free floating glochidia. These glochidia must wait to float into a fish by chance and can usually use multiple species of fish as hosts. Some species of mussels build a structure of mucus and glochidia, called a conglutinate. The female mussel uses the conglutinate as a "fishing lure" to attract a host fish. When a fish attempts to eat the bait, the conglutinate breaks apart releasing many glochidia in the fish's mouth. The glochidia are then able to attach to the gills. The conglutinates of some species are extremely specialized, and have a close resemblance to a small fish or aquatic invertebrate. Some species of mussel, such as the plain pocketbook (*Lampsilis cardium*), can use their mantle as bait for a passing fish. These mussels wave their specialized mantles, which resemble minnows, crawfish, or other small aquatic animals. When a fish is attracted, the female mussel retracts her mantle and releases her glochidia. The fish receives a mouth full of larvae which attach themselves to the host fish. Other species of mussel build a "net" or "web" of mucus and glochidia. When a host fish swims through the trap, the web breaks apart, freeing the glochidia which attach to the fish's fins. Mussels such as the exotic *Corbicula fluminea*, or the Asian Clam, do not require a host fish. Instead, their larvae are planktonic.

Once attached to a host fish, a cyst or small abscess forms around the glochidium. There the larval mussels undergo metamorphosis and become juvenile mussels. Some fish can build up a resistance to glochidia, and can only be parasitized once. Glochidia that become attached to resistant fish fall off the fish and die. The parasitic stage of mussel glochidia lasts anywhere from a week to several months. This extreme variation is believed to be affected by mussel species and water temperature. Once metamorphosis is complete, the new juvenile mussel drops off of its host, leaving the fish unharmed. The juvenile mussel will take at least a year to reach sexual maturity, and some species are known to take as long as four years.

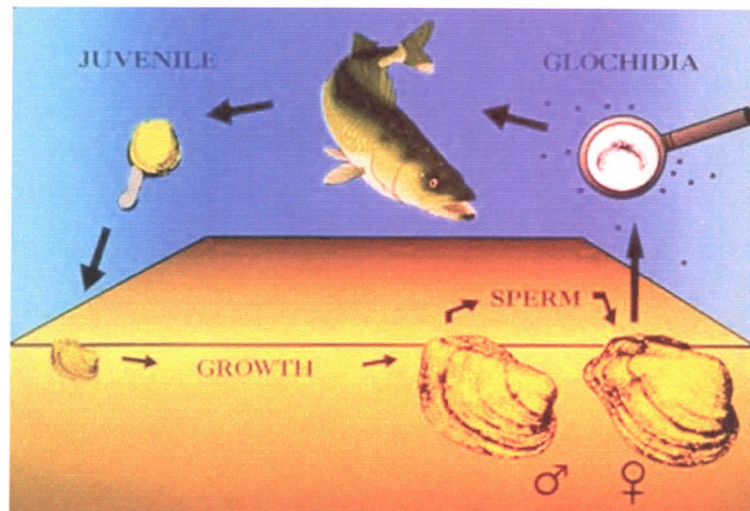


Figure 3: The Freshwater Mussel Life Cycle

Mussel Species List for St. Catherine Creek NWR

Anodonta suborbiculata
Flat Floater



Host Fish include the channel catfish, the warmouth, the green and longear sunfish, the largemouth bass, the golden shiner, and the white crappie.

Characteristics: The flat floater has a thin, smooth, circular shell. The periostracum ranges in color from yellow or yellow-green to dark brown, sometimes with green rays. The beak does not extend above the hinge line, and there are no teeth present. The nacre is white, sometimes light pink, and iridescent. Length can reach about seven inches.

Habitat: The flat floater prefers slow water and can be found in lakes, ponds, and oxbows and slow moving rivers, streams, and creeks. Mud is the preferred substrate of the flat floater.

Status: The mussel was found on St. Catherine Creek just above the large cement bridge (site 21S). The mussel is not abundant here, and the detritus bottom does not supply a good mussel habitat. Shells were also found upstream of the old cement ford (site 19S), but no live mussels were found here.

Lampsilis teres
Yellow Sandshell



Host Fish include the alligator, longnose, and shortnose gar, greenthroat darter, warmouth, bluegill, largemouth bass, yellow perch, white and black crappie, roach, shovelnose sturgeon, and the redbreast, green, and orangespotted sunfish.

Characteristics: The yellow sandshell is smooth, elongated, and moderately thick shelled. Yellow sandshells are often rayed and are yellow, greenish-yellow, or dark yellow-brown. The inside of the shell is white. The mussel has long thin lateral teeth, and fairly well pronounced pseudocardinal teeth. The beak is not extremely high, and extends just above the hinge. The mussel can reach up to six inches in length.

Habitat: The yellow sandshell is a common mussel in most of Louisiana and Mississippi and is found in slow to fast moving water in rivers, streams, creeks, and sometimes lakes and oxbows. Yellow sandshells prefer sand or fine gravel, but are not uncommon in muddy areas.

Status: The yellow sandshell can be found all along St. Catherine Creek. During this survey, the mussel was found at sites 16S, 19S, and 23S. The mussel was also found in Lake Butler at sites 17S and 18S. Several fresh dead shells were also found at site 24S. These shells may have floated down from the other sites. The mussel was common, but not abundant on the refuge.

Leptodea fragilis
Fragile Papershell



The **Host Fish** is the freshwater drum.

Characteristics: The fragile papershell, has, as its name suggests, a thin, fragile shell, with a smooth and glossy periostracum. The shell is yellow, sometimes with green or brown rays. The beak of this mussel is even with the hinge, which includes small, delicate teeth. The nacre is usually light pink, and iridescent. The mussel can reach up to six inches in length once mature.

The fragile papershell is sometimes confused with the pink papershell (*Potamilus ohioensis*) because the shapes are similar, and both have thin shells. The pink papershell, however, has a high wing on the posterior end of the hinge. When the pink papershell is missing its wings, the two species can be differentiated by nacre color. The pink papershell usually has dark pink nacre, while the fragile papershell has light pink or white nacre.

Habitat: The fragile papershell requires a medium to fast current and typically resides in streams and rivers. Mud, sand, or gravel is a good substrate for the mussel. The fragile papershell may bury deep into the substrate.

Status: The mussel is not uncommon on St. Catherine Creek. During this survey, the mussel was found at sites 19S, 21S, and 23S. Shells were found at sites 16S and 23S.

Ligumia subrostrata
Pondmussel



The pond mussel is a *sexually dimorphic* species, meaning males and females of this species have different shells. Males typically have a more pointed posterior end, while the females' posterior end is more rounded. Pictured here is a male pondmussel.

Host Fish include the green sunfish, warmouth, largemouth bass, and bluegill.

Characteristics: The pondmussel has a small, elongated shell. The periostracum can be any where from greenish yellow to brown or black, often with dark green rays. The beak is only slightly elevated above the hinge line, and the teeth are thin. The nacre is an iridescent white. The pondmussel is fairly small, and only reaches about three inches in length.

Habitat: The pondmussel is usually found in smaller bodies of water such as creeks, ponds, bayous, and oxbows. Pondmussels prefer a mud or sand substrate.

Status: Only one mussel was found on St. Catherine Creek NWR, at site 17S. The mussel is likely to occur in some of the other sloughs, swamps, and perennial ditches located on the refuge.

Potamilus capax
Fat Pocketbook



Host Fish is the freshwater drum.

Characteristics: The fat pocketbook shell is round and inflated. Its periostracum can be yellow, tan, or brown. The beak is high and extends well above the hinge line. The teeth are thin, but well developed. The nacre is white, sometimes with a hint of pink. The mussel can reach about five inches in length once mature.

This mussel can be mistaken with the plain pocketbook (*Lampsilis cardium*), but can be distinguished by the 'S' shaped hinge line which contrasts to the straighter hinge line of the plain pocketbook.

Habitat: The fat pocketbook resides in large streams and rivers with a moderate current and a sand or sandy gravel bottom.

Status: No live mussels were found on St. Catherine Creek NWR. Numerous dead shells were found above the ford (site 19S), but most were weathered and old. Two shells were found at site 23S. The habitat at both these sites was suitable for the fat pocketbook. The mussel may still be present but is not common.

The fat pocketbook is a federally listed endangered species.

Potamilus ohiensis
Pink Papershell



Host Fish include the freshwater drum, and the white crappie.

Characteristics: The pink papershell has a compressed, thin, fragile shell with a large wing on the posterior side of the beak, and a smaller wing on the anterior side of the beak. The beak extends almost even with the hinge line. The teeth are small and thin. The periostracum can be anywhere from dark yellow to dark brown. The mussel can reach up to seven inches in length.

When the pink papershell's distinctive wings have been broken off, its shell is easily confused with the fragile papershell (*Leptodea fragilis*). They can be differentiated by the dark purple or dark pink nacre of the pink papershell which contrasts to the white or light pink nacre of the fragile papershell.

Habitat: The pink papershell is usually found in rivers with a medium to strong current. These mussels prefer silt, sand, and mud substrates.

Status: The pink papershell may persist on St. Catherine Creek NWR, but during this survey only a few weathered dead shells were found at site 19S.

Pyganodon grandis
Giant Floater



Host Fish include the skipjack herring, yellow bullhead, freshwater drum, central stoneroller, Rio Grande cichlid, brook stickleback, gizzard shad, branded killfish, brook silverside, pumpkinseed, bluegill, blacknose dace, roach, creek chub, and several species of bass, suckers, darters, gar, sunfish, shiners, minnows, crappie, perch, and carp.

Characteristics: The giant floater has an elongated, thin shell. Its beak extends above the hinge, and it has no teeth. The nacre color varies from bright white to copper-colored. The periostracum is yellow or brown, sometimes with a hint of green. The mussel's length can reach ten inches.

Habitat: The giant floater prefers slow moving water. The mussel can be found in sloughs, lakes, ox bows, and slow streams or rivers. Bodies of water with a soft mud bottom are preferable.

Status: The mussel is both common and abundant on the St. Catherine Creek NWR. The mussel is found up and down St. Catherine Creek and in Butler Lake. Live mussels were found at sites 16S, 17S, 18S, 19S, and 23S. Dead shells were found at site 23S.

Quadrula apiculata
Southern Mapleleaf



Host Fish include several species of catfish, bass, and sunfish.

Characteristics: The Southern mapleleaf is brown, dark brown, or greenish brown, and the shell is usually thick. The nacre is pearly white, and iridescent. The beak is elevated slightly above the hinge line, and the teeth are broad. The Southern mapleleaf can grow to about four inches in length.

The shell of the Southern mapleleaf is very similar to that of the mapleleaf (*Quadrula quadrula*). The mapleleaf, unlike the Southern mapleleaf, has no pustules in the sulcus.

Habitat: The Southern mapleleaf is found in a variety of habitats, in currents ranging from fast to slow. Mud, sand, or gravel is the preferred substrate of the Southern mapleleaf.

Status: The mussel can be found in St. Catherine Creek just upstream of the ford (site 19S). The mussel is not common on the refuge. Dead shells also were found below the Butler Lake spillway (site 18S).

Quadrula quadrula
Mapleleaf



The **Host Fish** is the flathead catfish.

Characteristics: The mapleleaf can be brown, dark brown, and greenish brown. The nacre is pearly white, and iridescent. The beak is elevated slightly above the hinge line, and the teeth are broad. The mapleleaf has two groups of nodules separated by the sulcus. The mussel can grow to about four inches in length.

This smooth sulcus distinguishes the mapleleaf from the Southern mapleleaf (*Quadrula apiculata*), which has pustules extending through the sulcus.

Habitat: The mapleleaf is found in a variety of habitats, with current ranging from fast to slow. Mud, sand, or gravel is the preferred substrate of the mapleleaf.

Status: The mussel is fairly abundant on St. Catherine Creek NWR. The mapleleaf was found in Butler Lake at sites 18S and 24S and in St. Catherine Creek at sites 19S and 20S. Dead shells were found outside of the blue hole and the mussel is probably present in the hole.

Toxolasma parvus
Lilliput



The lilliput is a *hermaphroditic* species, or has both male and female sex organs. The mussel also has a *caruncle* or a ball of red or pink tissue on the edge of the mantle. The mussel uses this as a lure to attract host fish for its glochidia. When the host fish “takes the bait,” the lilliput retracts the caruncle and releases a burst of glochidia into the fish’s mouth.

Host Fish include the green and orangespotted sunfish, warmouth, bluegill, and white crappie.

Characteristics: The lilliput, the smallest of the freshwater mussels, only reaches 1 ½ to 2 inches. The mussel has a small, slightly inflated shell. The periostracum is usually dark green or brown in color. The nacre is typically white, or bluish white, and iridescent. The teeth are thin, and the beak is raised just above the hinge line.

The lilliput looks similar to the Texas lilliput (*Toxolasma texasiensis*) and the little spectaclecase (*Villosa lienosa*), but the lilliput is smaller than either of these species. The male Texas lilliput is also more elongated. The little spectaclecase can usually be distinguished by its pink or purple nacre. Also, both the lilliput and the Texas lilliput have a *caruncle*, or ball of red or pink tissue on the mantle. The little spectaclecase lacks this.

Habitat: The lilliput is often found in the shallows along the edges of ponds, lakes, rivers, streams, sloughs, oxbows and creeks. This mussel does not require a current and prefers mud, sand, and fine gravel substrates.

Status: The lilliput is present on St. Catherine Creek and in Butler Lake. During this survey, the mussel was found alive 200 yards downstream from the ford on St. Catherine Creek (site 23S). Fresh dead shell was also found below the Lake Butler spillway (site 18S). The mussel is not abundant, or common.

Toxolasma texasiensis
Texas Lilliput



The Texas lilliput is a *sexually dimorphic* species, meaning the male and female mussels have differently shaped shells. Pictured here are a male and female lilliput. The male, on the left, is more elongated, and does not have a broad posterior end like the female, on the right.

Host Fish include the bluegill and the warmouth.

Characteristics: The Texas lilliput has an elongated, slightly inflated shell. The periostracum is usually smooth and dark green, brown, or black. The beak is not high, and extends just above the hinge line. The teeth are thin, and the nacre is white, sometimes with a hint of pink. The Texas lilliput can grow to three inches, but are rarely bigger than 2 ½.

The female Texas lilliput looks similar to the lilliput (*Toxolasma parvus*), but grows much larger. Also, the nacre of the Texas lilliput is not as bright white as that of the lilliput. The female Texas lilliput is also similar to the little spectaclecase (*Villosa lienosa*), but lacks the purple nacre. The female Texas lilliput also has a caruncle attached to its mantle which can distinguish it from the little spectacle case.

Habitat: The Texas lilliput is found in streams, rivers, creeks, bayous, and sloughs. The mussel prefers a slow to medium current and a mud or sand substrate. The mussel is more common in shallow water than deep, and is usually found near the banks of rapidly flowing rivers or streams.

Status: The Texas lilliput was very common on St. Catherine Creek. The mussel was found at sites 16S, 19S, 21S, and 23S. At the sites 19S and 23S, the mussel is very abundant. The mussel was also found in Butler Lake both above and below the spillway (sites 17 and 18). There were fresh dead shells found on the banks of the blue hole (site

22), indicating that the Texas lilliput is probably there, but the water was too deep to sample.

The Texas lilliput has a *caruncle* or a ball of red or pink tissue on the edge of the mantle. The mussel uses this as a lure to attract host fish for its glochidia. When the host fish “takes the bait,” the mussel retracts the caruncle and releases a burst of glochidia into the fish’s mouth.

Unio merus tetralasmus
Pondhorn



The **Host Fish** is the golden shiner.

Characteristics: The shell of the pondhorn is fairly thin, elongate, and light to dark brown. The periostracum is smooth, and the nacre is white or light pink. The teeth are thin and small. The beak is not high and usually stops even with the hinge line. This mussel can reach five inches in length.

Habitat: The pondhorn prefers slow moving or still water, and is typically found in ponds, lakes, oxbows, and small creeks. The mussel prefers a mud or a sand substrate.

Status: The mussel was not found on St. Catherine Creek NWR, but is likely to occur in some of the sloughs, lakes, bayous, perennial ditches, and swamps located on the refuge

Utterbackia imbecillis
Paper Pondshell



Host Fish include the mosquitofish, pumpkinseed, warmouth, bluegill, and creek chub along with several species of bass, killfish, shiners, darters, sunfish, perch, and crappie. The paper pondshell has even been known to use the bullfrog as a host.

Characteristics: The paper pondshell has a very thin shell, which is yellow to yellow-green in color. The nacre is white to bluish white. The beak does not extend over the hinge, and the shell is oblong. This shell has no teeth. Length is about four inches for adults.

Habitat: The paper pondshell is typically found in still or very slow moving water. The mussel occurs in ponds, lakes, and some streams, rivers, and creeks. Mud is the preferred substrate of the paper pondshell.

Status: Several fresh dead shells were found on St. Catherine Creek NWR at sites 17S and 23S. The mussel is likely to occur also in the sloughs, swamps, bayous, and perennial ditches on the refuge.

The paper pondshell is a *hermaphroditic* species, or has both male and female sex organs.

Corbicula fluminea
Asian Clam



Asian clams are an introduced species. They are known to form dense single species beds containing thousands of mussels per square meter.

The glochidia of the Asian clam go through a planktonic stage rather than a parasitic phase. Therefore, these mussels do not require a host fish. Also, the Asian clam is a hermaphrodite, and is capable of self fertilization.

Characteristics: The Asian clam is small with a slightly rounded or triangular shape. The beak is high and located in the center of the shell. The periostracum is yellow to brown or black. The teeth are small, and the nacre is white, purple, or pink. The mussel only reaches about 1 ½ inches.

Habitat: The Asian clam resides in rivers, streams, creeks, lakes, ponds, sloughs, and oxbows and can live in silt, sand, mud, or gravel.

Status: The clam was found in St. Catherine Creek just above the ford (site 19S). Dead shell was also found 200 yards downstream at site 23S. The Asian clam is not abundant here.

St. Catherine Creek NWR Survey Sites
Monday, July 15, 2002

Site 16S: St. Catherine Creek

Just downstream of the old ford; soft mud; three to five foot deep water; slow current; mussels scattered

Tuesday, July 16, 2002

Site 17S: Butler Lake

Above the spillway; deep, soft mud; mussels fairly abundant;

Site 18S: Butler Lake

Below the spill way; deep, soft mud; slow current; water up to three feet deep; mussels fairly abundant

Site 19S: St. Catherine Creek

Just upstream of the old ford; mud, gravel, and sand substrate; current present; water two to four feet deep; mussel bed extending 200 feet upstream; shells abundant, live mussels fairly abundant

Site 20S: St. Catherine Creek

250 yards upstream from the old ford; water three to six feet deep; large clean gravel over soft mud; no current; only live mapleleaves found-scattered

Site 21S: St. Catherine Creek

Above the large cement bridge; slow current; detritus and mud bottom; deep pools; mussels very scattered; numerous alligator gar

Wednesday, July 17, 2002

Site 22S: Blue Hole

Soft mud; too deep to sample the hole; numerous fresh dead shells in the channel below the hole with scattered live mussels found suggesting mussels do persist in the hole

Site 23S: St. Catherine Creek

About 200 yards downstream from the old ford; wide channel; shallow water; sandy bottom; lasts about 200 yards, then opens into Butler Lake; mussels scattered

Site 24S: Butler Lake

Below the spillway bridge (Salt Lake Rd.; heavy gravel; water four to five feet deep; live mussels common; gravel fades into deep, soft mud; channel deepens; no shell found downstream of the gravel

Mussels Occurring on St. Catherine Creek National Wildlife Refuge

| <u>Common Name</u> | <u>Scientific Name</u> | <u>Sites Found</u> |
|--------------------|-------------------------|---|
| Flat Floater | <i>A. suborbiculata</i> | 19S, 21S |
| Yellow Sandshell | <i>L. teres</i> | 16S, 17S, 18S, 19S, 23S, 24S |
| Fragile Papershell | <i>L. fragilis</i> | 16S, 19S, 21S, 22S, 23S |
| Pondmussel | <i>L. subrostrata</i> | 17S |
| Fat Pocketbook | <i>P. capax</i> | 19S, 23S |
| Pink Papershell | <i>P. ohiensis</i> | 19S |
| Giant Floater | <i>P. grandis</i> | 16S, 17S, 18S, 19S, 22S, 23S |
| Southern Mapleleaf | <i>Q. apiculata</i> | 18S, 19S |
| Mapleleaf | <i>Q. quadrula</i> | 18S, 19S, 20S, 22S, 24S |
| Lilliput | <i>T. parvus</i> | 18S, 23S |
| Texas Lilliput | <i>T. texasiensis</i> | 16S, 17S, 18S, 19S, 21S, 22S, 23S |
| Pondhorn | <i>U. tetralasmus</i> | |
| Paper Pondshell | <i>U. imbecillis</i> | 17S, 23S |
| Asian Clam | <i>C. fluminea</i> | 19S, 23S |

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<http://fly.hiwaay.net/~dwills/nasc.html>

http://outdoorplace.org/shells/local_shells.html

http://www.umesc.usgs.gov/reports_publications/psrs/psr_2000_04.html

http://www.inhs.uiuc.edu/chf/pub/mussel_man/cover.html

<http://courses.smsu.edu/mcb095f/gallery/Default.htm>

For host fish information, go to:

<http://ellipse.inhs.uiuc.edu/fmcs/>